CONSTRUCTION STANDARD SPECIFICATION

SECTION 15083

PIPE AND EQUIPMENT INSULATION

CONSTRUCTION STANDARD SPECIFICATION

SECTION 15083

PIPE AND EQUIPMENT INSULATION

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes preformed, rigid and flexible pipe insulation; field-applied jackets; accessories and attachments; and sealing compounds for above ground, interior and exterior mechanical piping systems as listed in Part 3 application schedules. This section also includes mechanical equipment insulation requirements.

1.02 REFERENCES

A. American Society of Testing and Materials (ASTM)

B 209 Aluminum and Aluminum-Alloy Sheet and Plate

C 533 Calcium Silicate Block and Pipe Thermal Insulation

C 534 Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tube Form

C 547 Mineral Fiber Pipe Insulation

C 553 Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications

C 612 Mineral Fiber Block and Board Thermal Insulation

C 795 Thermal Insulation for Use in Contact with Austenitic Stainless Steel

E 84 Standard Test Method for Surface Burning Characteristics of Building Materials

B. American National Standards

A 117.1 Accessible and Usable Buildings and Facilities

C. Military Specification

MIL-C-19565C Coating Compounds, Thermal Insulation, Fire- and Water-Resistant, Vapor-Barrier

1.03 SUBMITTALS

A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated. Provide manufactures installation requirements for each type of insulation and piping. Show compliance with necessary industry standards and listing agencies.

1.04 QUALITY ASSURANCE

A. All insulating materials required for piping shall be furnished and installed under this contract. The execution of the work shall be in strict accordance with the best practices of the trade, the manufacture's requirements, and the intent of this specification.

B. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.

2. Insulation Installed Outdoors: Flame-spread rating of 75 or less, and smoke-developed rating of 150 or less.

C. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups according to the following requirements for interior and exterior applications, using materials indicated for the completed Work:

1. Include the following mockups:

a. One 10-foot section of 2 inch NPS straight pipe.
b. One 90-degree elbow.
c. One tee fitting.
d. One 2 inch valve.

e. Four support hangers, including hanger shields and insert.
f. One strainer with removable portion of insulation.
g. One reducer.

2. Build mockups in the location indicated by SDR.

3. Obtain SDR approval of mockups before starting insulation application.

4. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

5. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

D. Inspection: Perform the following field quality-control inspections, after installing insulation materials, jackets, and finishes, to determine compliance with requirements:

1. Inspect fittings and valves randomly selected by SDR.

2. Remove fitting covers from 20 elbows or 1 percent of elbows, whichever is less, for various pipe sizes.

3. Remove fitting covers from 20 valves or 1 percent of valves, whichever is less, for various pipe sizes.

E. Insulation applications will be considered defective if sample inspection reveals noncompliance with requirements. Remove defective Work and replace with new materials according to these Specifications.

F. Reinstall insulation and covers on fittings and valves uncovered for inspection according to these Specifications.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Insulation materials shall be new and undamaged with the manufacture's name and brand marking clearly displayed on all containers.

B. Insulation materials shall be kept dry and protected from the weather at all times until installation is complete. Insulation material found to be wet or damaged shall be replaced by the contractor at no cost to the owner.

PART 2 - PRODUCTS

2.01 INSULATION MATERIALS

A. Mineral-Fiber Insulation: Glass fibers bonded with a thermosetting resin complying with the following:

1. Preformed Pipe Insulation: Comply with ASTM C 547, Type I-Molded, for use to 850 deg. F, with factory-applied, all-purpose, vapor-retarder jacket (ASJ), with self-sealing adhesive lap (SSL). Minimum 3 lbs./cu.ft. density, maximum 0.23 (BTU-in./hr.-sq.ft.-deg. F) at 75 deg. F thermal conductivity.

2. Blanket Insulation: Comply with ASTM C 553, Type II, without facing.

3. Pipe and Tank Insulation: Semi-rigid fiberglass board in a roll form faced with factory applied vapor retarder jacket (ASJ). Comply with ASTM C 795, Type II, for use to 850 deg. F. Maximum condutivity, 0.26 (BTU-in./hr.-sq.ft.-deg. F) at 100 deg. F.

4. Mineral–Fiber Board Thermal Insulation: Comply with ASTM C 612, Type IB, for use to 450 deg. F, with a factory applied jacket manufactured from foil, reinforcing scrim, and kraft paper (FSK). Minimum density of 3 lb./cu.ft. Maximum conductivity of 0.40 (BTU-in./hr.-sq.ft.-deg. F) at 300 deg. F.

5. Vapor-Retarder Mastics: Fire- and water-resistant, vapor-retarder mastic for indoor applications. Comply with MIL-C-19565C, Type II.

B. Flexible Elastomeric Thermal Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Adhesive: As recommended by insulation material manufacturer.

2. Ultraviolet-Protective Coating: As recommended by insulation manufacturer.

C. Calcium Silicate Insulation: Preformed pipe sections of non-combustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.

D. Standard PVC Fitting Covers: Factory-fabricated fitting cover system consisting of one-piece, pre-molded, PVC covers with fiberglass inserts manufactured from 20-mils thick, high-impact, ultraviolet-resistant PVC.

1. Shapes: 45- and 90-degree, short- and long-radius elbows, reducers, end caps, soil-pipe hubs, traps, mechanical joints, roof drains, and P-trap and supply covers for lavatories for the disabled.

2. Adhesive: As recommended by insulation material manufacturer.

2.02 FIELD-APPLIED JACKETS

A. Aluminum Jacket: Aluminum roll stock, ready for shop or field cutting and forming to indicated sizes, or factor cut and rolled. Comply with ASTM B 209, 3003 alloy, H-14 temper.

1. Finish and Thickness: Stucco-embossed finish, 0.016 inch thick.

2. Moisture Barrier: 1-mil thick, heat-bonded polyethylene and kraft paper.

3. Elbows: Preformed, 45- and 90-degree, short- and long-radius elbows; same material, finish, and thickness as jacket.

B. PVC Jacket: White, 25/50 rated per ASTM E 84, UV resistant, minimum thickness 0.020" for insulation O.D. up to 18" and 0.030" for insulation O.D. above 18"

1. Fittings – See 2.01D "Standard PVC Fitting Covers"

2.03 ACCESSORIES AND ATTACHMENTS

A. Bands: Aluminum; 0.007 inch thick 3/4 inch wide.

B. Bands: Stainless Steel, ASTM A666, Type 304, 0.020 inch thick.

C. Manufactured Thermal Hanger Shields: Thermal inserts shall be 360 degree calcium silicate extending 1 inch past the metal shield and with all service jacket. Sized to fit the pipe diameter and match the outside diameter of the adjoining pipe insulation. Metal shield shall be galvanized steel 180 degree for clevises and roller type hangers and 360 degree for clamp type hangers and supports. Shield and insert length and gauge shall be manufactures standard for the intended application.

PART 3 - EXECUTION

3.01 PREPARATION

A. Surface Preparation: Clean and dry pipe and fitting surfaces. Remove materials that will adversely affect insulation application.

3.02 GENERAL APPLICATION REQUIREMENTS

A. Apply insulation to piping systems using materials, thickness and jackets listed in the schedule at the end of this section.

B. Piping exposed to the weather: Any piping subject to freezing and any piping with heat tracing shall have the insulation thickness increased by an additional 2-inches mineral insulation of the same finish as specified for the particular service when not subject to freezing.

C. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:

1. In steam, hot water, domestic and non-potable service only: Flexible connectors, unions, pressure reducing valves, balancing valves, flow control valves, steam traps, and in sizes less that 1-1/2", valves and strainers.

2. Fire-suppression piping.

D. Handicap Lavatories: Cover all exposed lavatory supply and waste fittings with insulation and removable PVC covers to comply with ANSI Std. A117.1 requirements.

E. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties. Apply insulation with the least number of joints practical.

F. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.

G. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and floors unless not allowed by fire stop system. Firestopping and fire-restive joint sealers are specified in Section 07270, "Firestop and Smokestop Systems"

H. Hangers and Anchors: Provide factory or field fabricated rigid insulation inserts with metal shields at all hangers of horizontal piping and anchors of vertical piping. Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.

3.03 COORDINATION

A. Coordinate with other trades so as to cause no delays in applying insulation; be aware of testing, painting, hanger installation and heat tracing requirements. Coordinate clearance requirements with piping Installer for insulation application.

B. Protect work of other Contractors and SNL from dirt and debris caused by the insulation work. Remove rubbish daily and at the conclusion of work.

C. Do not insulate over nameplates or sight /light glasses.

D. Coordinate with pump layout to insure pressure switches and gauges are extended outside of pump insulation boxes.

3.04 MINERAL-FIBER INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows: Use preformed pipe insulation when able. Use pipe and tank insulation for larger diameter piping where

preformed insulation is not available. To meet required thickness, apply multiple layers of insulation with longitudinal and end seams staggered.

1. Keep SSL adhesive and contact surfaces clean and free of dirt and moisture. Seal immediately once adhesive is exposed. Seal circumferential joints with a minimum 3 inch wide tape and secure with two outward clinching staples at the overlap. Rub the longitudinal joints firmly with a squeegee and secure with 2 outward clinching staples evenly spaced in each 3 foot section of insulation.

2. Where vapor retarders are indicated; Seal staples and any penetrations in the insulation with vapor-retarder mastic. Apply vapor retarder to ends of insulation at intervals of 15 to 20 feet to form a vapor retarder between pipe insulation segments.

3. Taper the ends of inslation at terminations. Seal all raw edges of insulation with mastic.

B. Apply insulation to flanges as follows:

1. Apply preformed pipe insulation to outer diameter of pipe flange.

2. Make width of insulation segments the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with a collar fabricated for preformed pipe insulation.

4. Fill all voids and seal all raw edges of insulation with vapor retarder mastic.

C. Apply insulation to fittings and elbows and mechanical grooved couplings as follows:

1. Apply mitered sections of pipe insulation, or glass-fiber blanket insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire, tape, or bands.

2. Cover fittings with standard PVC fitting covers. Secure the fitting covers by wrapping the ends with minimum 1-1/2" wide PVC tape. Overlap a minimum of 2" and do not stretch the last 2" of tape. Secure the throat with a stainless steel tack.

3. On systems requiring a vapor barrier, seal the throat with vapor barrier mastic (the PVC fitting cover is to act as the vapor barrier).

D. Apply insulation to valves and specialties as follows:

1. Apply premolded pipe insulation sections of the same material as straight segments of pipe insulation, sized and cut to fit around the valve body, over the flanges, and around the bonnet. Fill all voids and seal all raw edges in insulation with vapor retarder mastic. Caulk around valve stem cutout.

2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to strainer basket without disturbing insulation.

3. Apply insulation to flanges as specified for flange insulation application.

3.05 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION

A. Follow manufacturer's written instructions for applying insulation to straight pipes, tubes, and fittings.

1. Seal longitudinal seams and end joints with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

3.06 CALCIUM SILICATE INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:

1. Secure each layer of insulation to pipe with stainless-steel bands at 12-inch intervals and tighten without deforming insulation materials.

2. Apply two-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 0.062-inch soft-annealed, stainless-steel wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.

3. Apply an aluminum jacket to cover all insulation. See section on jacketing.

3.07 FIELD-APPLIED JACKET APPLICATION

A. Interior: Apply either aluminum or PVC jacketing to exposed insulated pipe, valves, fittings, and specialties, at an elevation of 8 feet or less above finished floor in mechanical/electrical rooms, penthouses, and services aisles/pipe chases. Fittings of aluminum jacketed piping may be either aluminum or standard PVC fitting covers. Jacketing for piping in existing areas shall match existing jacketing.

B. Exterior: Apply aluminum jacketing to all external piping that is insulated. Cover all fittings, valves, and specialties with aluminum jacketing.

C. Apply metal jacket where indicated, with 2-inch overlap at longitudinal seams and end joints. Secure jacket with aluminum bands or sheet metal screws on 12 inches centers and at end joints. On piping exposed to the weather, overlap longitudinal seams arranged to shed water and seal end joints with weatherproof mastic.

D. Apply PVC jacketing where indicated, with 2-inch overlap at longitudinal seams and and at fitting covers, the maximum the cover allows. Seal longitudinal seams by joining with PVC welding solvent. Seal circumferential ends with 1/1/2” PVC tape.

3.08 EQUIPMENT

A. Hot Water Convertors, Hot Water Storage Tanks, Condensate Receivers, Flash Tanks, Separators and Blow-Off Tanks(not factory insulated):

1. Insulate with 1-1/2" fiberglass preformed pipe or "pipe and tank" insulation. Secure insulation with banding on vessels 3 foot in diameter and larger. Finish with aluminum jacketing and secure with metal bands or sheet metal screws. Secure jacketing with stainless steel banding on vessels 6 foot in diameter and larger.

B. Steam Condensate Pumps (unless factoy insulated jacket is provided with pump): Insulate with a removable, reusable custom fit cover manufactured from teflon-impregnated cloth with double sewn and binded seams and 1 inch thick fiberglass. Suitable for continuous temperatures to 500 degrees F.

C. Chilled Water and Process Chilled Water Pumps (Operating at 45 deg. F or less or as indicated on the drawings):

1. Base Mounted Pumps; Insulate with 1/1/2" thick rigid fiberglass board applied with adheasive to the interior (FSK facing the interior of the box) of aluminum sheet metal boxes that are constructed to tightly fit the pump housing and rigid enough to be removed and re-installed without deforming.

2. In-line Pumps; Insulates with 1-1/2" thick rigid fiberglass board with an FSK jacket to a box shaped to fit the pump housing and with edges secured with matching FSK tape.

D. Roof Drains:

1. Wrap roof drain sump with 1-½" thick fiberglass blanket and cover with a premolded PVC cover.

3.09 FINISHES

A. Paint insulation finished with all service jacket as specified in Section 09900, "Painting."

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of the insulation manufacturer's recommended protective coating.

Table 1

Insulation Schedule

Piping System *(See Note 2)*	**Operating Temp. ° F**	**Pipe Size** *1" & Below*	**Pipe Size** *1-1/2" to 2"*	**Pipe Size** *2-1/2" to 4"*	**Pipe Size** *Above 4"*	**Material**	**Vapor Barrier**
High Pressure Steam	306 to 400	2-1/2"	2-1/2"	3"	4"	M.F.	No
Medium Pressure Steam	251 to 305	2"	2-1/2"	3"	3"	M.F.	No
Low Pressure Steam	200 to 250	1-1/2"	1-1/2"	2"	2"	M.F.	No
Condensate	190 to 220	1"	1-1/2"	2"	2"	M.F.	No
Heating Water	120 to 200	1"	1"	1-1/2"	1-1/2"	M.F.	No
Chilled Water	Up to 58	1"	1"	1"	1"	M.F.	Yes
Process Cooling Water	Up to 65	1"	1"	1"	1"	M.F.	Yes
Process Cooling Water	66 to 110	N.R.	N.R.	N.R.	N.R.	None	Yes
Condensate Drains	35 to 70	1"	1"	1"	1"	M.F.	Yes
Domestic Cold & Non Potable Water *(See Note 1)*	55 to 65	1"	1"	1"	1"	M.F.	Yes
Domestic Hot & Recir. Water	100 150	1'	1"	1-1/2'	1-1/2'	M.F.	No
Roof Drains	32 to 65	1'	1'	1"	1'	M.F.	Yes
Engine Exhaust	100+	1"	1"	1"	1"	C.S.	No
Refrigerant Suction	25 to 55	3/4"	3/4"	3/4"		F.E.	Yes

Note 1. Insulation of domestic cold and non-potable water is only required in exterior walls, in ceiling spaces below roofs, and in areas subject to freezing.

Note 2. All piping exposed to the weather, in unheated spaces, or with heat tracing shall have 2” of insulation added to the values in the table.

END OF SECTION 15083